# ACCURACY
# for ANGLES and TAPERS

By GEOMETER



**A**CCURACY of a square can be checked by two discs of the same diameter fixed by screws to a piece of plate, and set so that the blade of the square touches both when the stock is applied to the edge of the plate. By turning the square over when the blade has touched the discs one side, so that it touches them the other side, accuracy of the square can be proved. By this method also, it is possible to set the two discs at right angles to the edge to which the stock of the square is presented-as at *A*, where the square is an adjustable type, or clinograph.
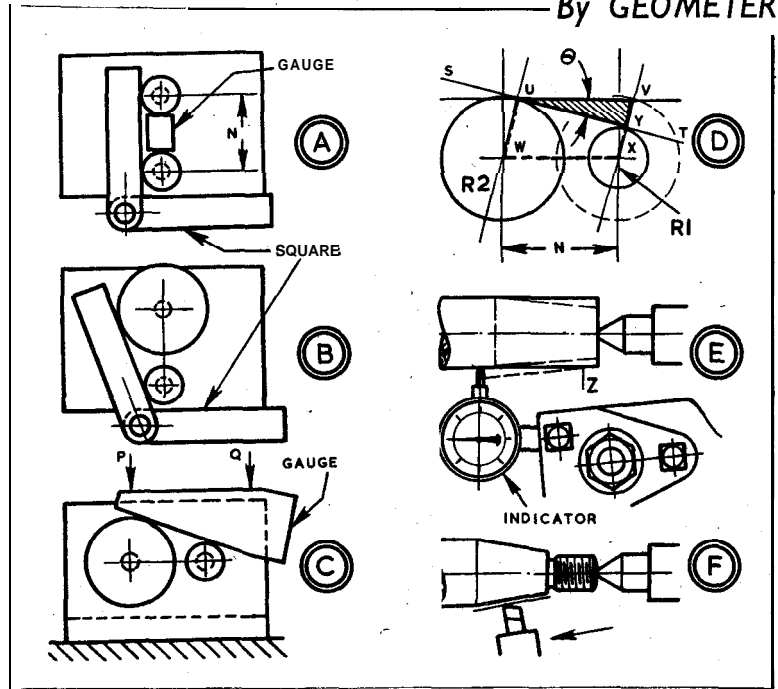
On this principle, using discs of different diameter, angles either side of the vertical can be obtained accurately, and an adjustable square set to them for laying out or checking work. The setting can be done at least as accurately as when using an expensive adjustable square with vernier-and only micrometers are needed for turning the discs and making a gauge for spacing the first pair.

### Setting the discs

The setting is done as at *A*. The discs are mounted vertically in the straight-edged plate by shanks threaded for nuts, which hold them securely. The shank of the one further from the edge is a close fit in its hole, and all other shanks are similarly well-fitting here. The shank of the other has some play in its hole for setting truly by a square, and an end gauge is placed between the two discs for spacing accurately to distance N. The diameter of the discs can be to choice, as can the spacing; for many purposes the discs can be 1/2in. dia., and their spacing 1 in.

Once the discs have been set and the one nearer the edge firmly fixed by the nut on its shank, the other can be removed and a larger substituted, as at *B*. The blade of the square can then be set to angle. Thus, with the plate having one accurately fixed disc, others can be used for obtaining required angles.

For working on a surface plate, angles can be obtained in the same manner, as at C, where a small angle plate has been drilled to take discs. To mark off an angle gauge, plate material can be stood on the discs and clamped: and at the finish, an accurate check can be made with a surface gauge or indicator at points *P* and Q, which should be horizontal.

### Using trigonometry

Dimensions of discs can be found using trigonometrical tables. The sine is a decimal fraction, and tables may be to six figures with angles and degrees in minutes. With spacing of discs 1 in., the fraction for each angle is an ordinary decimal fraction, and added to the radius -of the smaller disc to obtain that of the larger. If the spacing exceeds 1 in., then the fraction is multiplied by the spacing. For 5 deg. for example, sine is 0.087156 which is added *to* the radius of the smaller disc; so one is 0.250 in. radius, and the other 0.3371 in. radius.

Proof is as at *D*. Here the spacing is N and the angle 0. Line *S-T* is the required angle, and is a tangent to the two discs. Line *U-V* is horizontal on to another large disc of the same size This length is the same as *W-X*, or N. U, *V, W,* Xform a parallelogram, and *UYV* a right-angled triangle, with *VY/UV* equalling the sine. With spacing N at 1 in., VY is the fraction taken from the tables. Rl + *VY* = R2.

The principle *may be* adapted to set a lathe topslide accurately to angle for machining tapers on shafts. The slide is set approximately to angle, and the indicator mounted with its plunger at centre height and at right angles to. the parallel work, as at *E.* Beginning with the indicator at Z and set to 0, moving the slide 1 in. should bring the reading to correspond to the fraction for the sine; and while they do not agree, the slide requires adjustment.

To adjust a slide to a shaft already machined taper,, an approximate setting should agam be made, with the tool at centre height and brought fairly close to the shaft. Then checking by moving the tool, adjustments can be made to a parallel setting, as at